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Sequential injection chromatography – liquid chromatography in sequential injection analysis

The sequential injection analysis (SIA) is a high versatile analytical technique based on a multi-position selection valve (enables variable handling of solution in flow system) and syringe pump (provides forward and reverse movement of sequentially built liquid stream) [1]. All mentioned features favor the SIA technique for application in many fields of analysis, but usually for single analyte measurement [1,2]. In case multi-component analysis is necessary to change selectivity of the measurement by employing specific approaches – LLE, SPE, dialysis, separation etc.

The problem of simultaneous determination of analytes in mixtures (presence of several compounds or complex matrix) can be solved by using of non-separation tools in SIA. The simplest example is the utilization of selective detectors (based on different characteristic of analytes in mixture) – optical, electrochemical or spectral. The use of selective extraction techniques (LLE, SPE, dialysis, etc.) is common too. Specific manifold setups are used for further selectivity, sensitivity and miniaturization [3].

Coupling of short monolithic column with SIA opened a new possibilities in flow analysis – high selectivity and high performance of liquid chromatography for separation. The method described firstly in 2003 was called Sequential injection chromatography (SIC) and has been already successfully applied in the analysis of relatively simple multi-component samples - mainly in the field of pharmaceutical analysis [4].

Sequential injection chromatography is built on classical SIA manifold (later improved by pressure resistant SIChrom™ system). Chromatographic part originally represented (25 - 100 mm of length) commercially available monolithic column (with or without monolithic pre-column 5 or 10 mm length) [5] was later broaden with short particle packed columns (30 or 50 mm of length) – thanks to the introduction of core-shell particle technology (2.7 or 5.0 μm) [6].

Early SIC setups enabled separation of 2 – 4 analytes under isocratic elution conditions but with use of particle packed columns was separated 6 – 9 analytes were separated using gradient elution mode. The capability of SIC method was proved by application on pharmaceutical and environmental samples. Overall performance of the SIC enabled its hyphenation with on-line sample pre-treatment methods based on SPE which enabled to perform fully automated sample analysis using still quite simple flow system [7].

The SIA group (in Department of Analytical Chemistry, Faculty of Pharmacy in Hradec Kralove) of which Petr Chocholouš is member continually have presented gradual development of SIC method over last 12 years and is followed by several workgroups worldwide.

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